# An Assessment of Market Power in the U.S. Food Industry And Its Impact on Consumers

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Marketing activities account for the majority share of costs for most foods, and the share of costs due to marketing is rising over time. Consider that the farm share of the U.S. Department of Agriculture’s "market basket" of food products remained stable at about 40% from 1960-80 but has declined rapidly since then, to 30% in 1990 and 22% in 1998. In 1996 U.S. consumers spent $547 billion on food, excluding imports and seafood. The marketing bill was $424 billion, leaving $123 billion in farm value or 23%. This measure of the farm share has also been declining steadily over time, falling from 41% in 1950 to 31% in 1980 and then to 24% in 1990.

What explains this growth in the marketing sector’s share of the U.S. food dollar? Certainly, changes in consumers’ buying habits are one explanation. Increased demand for convenience, such as reduced time for meal preparation, and consumption of more meals away from home are examples that naturally cause more marketing services to be consumed per food dollar expended. Another consideration is the rapid increase in concentration in all stages of the food marketing sector. High concentration may be associated with the exercise of market power. Fundamental to the exercise of market power is the restriction of quantities relative to the competitive level so as to influence prices and increase profits. Because consumers’ welfare from food consumption is, in general monotonic in the quantity of food brought to the market place, exercise of market power *anywhere* in the market chain will reduce consumers' welfare.

This paper focuses specifically on the possible impacts on consumers of concentration and market power in the food chain. The analysis unfolds in several steps. First, we present a brief overview of key trends in food market concentration, defering more detailed discussion to companion papers. Second, we develop a simple and convenient, but relatively flexible model of a food market to study the potential impacts of market power at alternative stages of the market chain on the magnitude and distribution of economic welfare. We next examine and evaluate the empirical work that has been conducted to date on the existence and magnitude of market power in key food industries.

We then turn to the impact of market power in the food sector on economic welfare and the distribution of returns among producers, consumers, and marketers. This topic is of longstanding concern among agricultural economists and has featured some relatively recent contributions. We summarize and critique this body of work. One limitation is that work to date has emphasized food manufacturers' market power as sellers, yet concerns have also been expressed about food processors' oligopsony power as buyers of raw agricultural products and about the emerging power of retailers in the food chain. What are the potential welfare implications of both buyer and seller market power and of market power at successive stages in a food market? To help answer these questions, we utilize our analytical model to conduct a simulation analysis of potential welfare impacts for plausible ranges of market parameters, including processor and retailer market power. We conclude with policy implications of the analysis.

To maintain focus on the consequences of market power, we necessarily abstract away from several factors that contribute to determining welfare from food consumption. In particular, we focus on individual food commodities and utilize a partial equilibrium framework. Issues of product differentiation, variety, and interactions among food products are ignored. We also ignore for the most part the possible, even likely, linkages between concentration and efficiency in food marketing. Whereas these omitted issues are undoubtedly important, they are addressed in companion papers presented at this conference.

**A Brief Overview on Trends and Issues in Food Market Concentration**

Concentration in food manufacturing in the US has increased due to rapid growth of the largest manufacturers, fueled by mergers and consolidations. Rogers (1997) estimates that the top 100 US food manufacturers accounted for 80% of sales in 1995, doubling their cumulative share from 1954. Rogers reports increasing concentration in most of the 53 food and tobacco industries classified by four digit standard industrial classification (SIC) code; average CR4 in 1992 was 53.3% compared to 43.9% in 1967.

These reported concentration ratios apply only to food manufacturers in their role as sellers, although the power of food handlers as buyers from farmers has also long been an issue in agriculture. The relevant geographic and product markets for the purchase of raw agricultural commodities will usually be narrower, and, thus, concentration will normally be higher, than in the relevant markets for the associated finished products [Rogers and Sexton, (1994)]. Geographic markets are narrower because farm products are often bulky and/or perishable, causing shipping costs to be high, restricting the products' geographic mobility, and limiting farmers' access to only those buyers located close to the production site. In the product market dimension, processors' needs for agricultural products are highly specialized. Other inputs cannot normally be substituted for a given farm product, nor can a given farm product substitute for other agricultural product inputs in alternative production processes. For example, although pork, beef, and poultry may substitute for one another in consumers' budgets, they do not substitute at all as inputs into a particular processing plant.

On the farm product supply side, farmers are often specialized in the production of particular commodities through extensive investments in sunk assets, which represent exit barriers for these farmers and cause farm product supply to be inelastic. High buyer concentration in the relevant farm product markets and inelastic farm supply represent structural conditions conducive to the exercise of oligopsony power by processors and handlers. Although such power acts directly on farm producers, its consequence is to reduce production and sales at the farm level, an impact that will reverberate through the marketing chain, causing higher prices and reduced welfare to food consumers.

Food retailing in the U.S. is dominated increasingly by large chains of grocery supermarkets, and supercenters. Retail markets are inherently local in nature, making national or regional measures of concentration meaningless from the perspective of retailer oligopoly power over consumers. The average CR4 in grocery retailing for U.S. metropolitan areas has increased due to consolidations and mergers among grocery chains, reaching 68 percent in 1987, the most recent data available [Franklin and Cotterill, (1993)]. However, because the large chains normally use consolidated purchasing, concentration at the national level has implications for retailers' interactions with food manufacturers and wholesalers.

## A Simple Model of an Agricultural Market with Both Processing and Retailing Sectors

Consider a market where a primary agricultural product is procured from farmers by a processing sector, which then transfers the finished product to an independent retailing sector, where it is sold to consumers. Consumers' inverse demand for the retail product is

(1) $P^r = D(Q^r,| \mathbf{X})$,

where $Q^r$ is the market quantity of the retail product, $P^r$ is the market price, and **X** denotes unspecified demand shifters.

Farmers are assumed to be price takers in their output market. Inverse farm supply of the raw commodity is expressed as

(2) $P^f = S(Q^f| \mathbf{Y})$,

Where $P^f$ is the price received at the farm, $Q^f$ is the total volume of farm shipments, and **Y** represents unspecified supply shifters.

To sharpen the focus of the model on the implications of possible market power in the industry, we make a number of simplifying assumptions about the technologies for the processing and retailing sectors. Processors are assumed to utilize a fixed-proportions, constant-returns technology to convert the raw farm product into a finished product and, similarly, food retailers' technology also exhibits both fixed proportions and constant returns and is separable across the various products sold at retail. For convenience and without further loss of generality, we choose to measure units so that $Q^f = Q^w = Q^r = Q$, where the superscripts f, w, and r denote the farm, wholesale, and retail sectors, respectively. Given these assumptions, changes in market concentration have no cost-side effects, enabling the analysis to focus solely on the competitive impacts.

Denote a representative processing firm's volume of raw product purchases by $q^f$. Given our assumptions, the representative firm's variable cost function can be written as

(3) $$C^w = c^w(\mathbf{V}^w)q^f + P^f q^f,$$

where $c^w(\mathbf{V}^w)$ represents the constant processing costs per unit of raw product processed, and $\mathbf{V}^w$ is the vector of prices for variable processing inputs.

Denote a representative retailer's volume of wholesale purchases by $q^w$. A representative retailer's variable cost function for selling the product is

(4) $$C^r = c^r(\mathbf{V}^r)q^w + P^w q^w,$$

where $c^r(\mathbf{V}^r)$ represents the constant retailing costs per unit of wholesale product sold, and $\mathbf{V}^r$ is the vector of prices for variable retailing inputs. To simplify notation, we drop further reference to the exogenous variables $\mathbf{X}$, $\mathbf{Y}$, $\mathbf{V^w}$, and $\mathbf{V^r}$.

We now derive the implications of various combinations of oligopoly and oligopsony power in the processing and/or the retailing sector on total market surplus, and the distribution of surplus among consumers, producers, and marketers. Throughout the analysis, we assume that farm producers and consumers act as competitive price takers.

*Case I: Manufacturers or Retailers may have both Oligopsony and Oligopoly Power*

In this case we assume that *either* retailers or manufacturers are price takers, i.e., given market power in one of the marketing sectors, the other sector is competitive. Given the model structure, the output, farm price, consumer price, and aggregate welfare effects are identical for a given degree of market power regardless of whether the power is held by food processors or by food retailers. To simplify the exposition, we develop the case where food manufacturers may exercise market power and retailers are competitive. In this case, the retail price is $P^r = P^w + c^r$.

A representative processing firm's profit function can be expressed as

$$\pi^w = (D(Q^w) - c^r)q - S(Q^f)q - c^w q, \tag{5}$$

where $q = q^w = q^f$ is the firm's level of output and volume of farm product purchases. The first-order necessary condition for maximizing equation (5) is

$$\frac{\partial \pi^w}{\partial q} = P^w + \frac{\partial D(Q^w)}{\partial Q^w}\frac{\partial Q^w}{\partial q}q - (P^f + c^w) - \frac{\partial S(Q^f)}{\partial Q^f}\frac{\partial Q^f}{\partial q}q = 0. \tag{6}$$

Equation (6) can be written in elasticity form as

$$P^w\left(1 - \frac{\xi^w}{\eta^w}\right) = P^f\left(1 + \frac{\theta^f}{\varepsilon^f}\right) + c^w, \tag{6'}$$

where $\varepsilon^f = \frac{\partial Q^f}{\partial P^f}\frac{P^f}{Q^f}$ is the market price elasticity of supply of the farm product, $\eta_1^w = -\frac{\partial Q^w}{\partial P^w}\frac{P^w}{Q^w}$ is the absolute value of the market price elasticity of derived demand for the processed product when the retailer behaves competitively, and $\theta^f = \frac{\partial Q^f}{\partial q}\frac{q}{Q^f}$, $\xi^w = \frac{\partial Q^w}{\partial q}\frac{q}{Q^w}$ are the familiar conjectural elasticities. $2^f$ , [0,1] measures the processing firm's oligopsony market power in procuring the farm product and $>^w$ , [0,1] measures the firm's oligopoly power in selling the product to retailers. In either instance, a value of zero denotes perfect competition and a value of 1 denotes pure monopsony or monopoly. Forms of oligopoly and/or oligopsony competition, such as Cournot competition, are represented by intermediate values of $>$ and/or $2$, with higher values denoting progressively greater departures from competition.

The parameters $2^f$ and $>^w$ can be utilized independently of any specific interpretation as conjectural variations and instead viewed simply as indexes of market power that are the outcome of an unknown oligopsony and/or oligopoly game [Karp and Perloff, (1996)].[1] Aggregation from the firm to the industry is accomplished readily within this model framework. Because firms produce a homogeneous product and have identical technologies, optimizing behavior compels that *ex post* all firms' conjectures are identical [Wann and Sexton (1992)]. Equation (6') thus represents an equilibrium condition that, in conjunction with the retail demand and farm supply functions specified in (1) and (2), respectively, and the retailer cost function, (4), yields equilibrium values for $P^r$, $P^w$, $P^f$, and Q.

*Case II: Market Power at Successive Market Stages*

Here we consider scenarios where retailers may exercise oligopoly power over consumers and processors may exercise oligopsony power over farmers, and, in addition, processor-retailer interactions may be characterized by imperfect competition. We consider two alternative

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[1] The converse of this practice is the approach of Gasmi and Vuong (1991) and Gasmi, Laffont, and Vuong (1992) to econometrically impose the parameter restrictions implied by specific oligopoly/oligopsony models and use nonnested methods of hypothesis testing to distinguish

subcases for the processor-retailer interactions. The first involves processor oligopoly power and retailer price taking in the processor-retailer interactions, and the second involves retailer oligopsony power and processor price taking in the processor-retailer interactions. The case where both retailers and processors attempt to exercise market power in their mutual interactions must be studied within a bargaining environment, which is beyond the scope of the present study.[2]

For the subcase of successive oligopoly power, a representative retailer's profit function can be expressed as

(7) $\pi^r = D(Q)q - P^w q - c^r q$ ,

The first order condition for maximizing equation (7) is

(8) $P^r\left(1 - \frac{\xi^r}{\eta^r}\right) = P^w + c^r$ .

Using the retail demand function, D(Q), to substitute for $P^r$ in (8), we can solve equation (8) for the retailer's inverse derived demand function for the processed product: $P^w = D^w(Q*>^r, c^r)$.

A representative processing firm's profit function can then be expressed as

(9) $\pi^w = D^w(Q)q - S(Q)q - c^w q$ .

The first order condition for maximizing equation (9) is

(10) $P^w\left(1 - \frac{\xi^w}{\eta_2^w}\right) = P^f\left(1 + \frac{\theta^f}{\varepsilon^f}\right) + c^w$ ,

where $\xi^w$ denotes the degree of the processor's oligopoly power, and $\eta_2^w$ is the elasticity of

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among the various models.

[2] One plausible outcome of processor-retailer bargaining is that they would agree on the volume of trade that maximized their mutual benefit, with bargaining restricted to determining the division of surplus between the bargainers. This outcome is identical in terms of output, retail price, farm price, and welfare distribution to our Case I equilibria.

derived demand, given retailer oligopoly power. In general, $\eta_1^w \neq \eta_2^w$. Equations (1), (2), (8), and (10) define the market equilibrium for the subcase of successive oligopoly power.

For the subcase of successive oligopsony power, a representative processor's profit function can be expressed as

(11) $$\pi^w = P^w q - S(Q)q - c^w q,$$

The first order condition for maximizing equation (11) is

(12) $$P^w = P^f\left(1+\frac{\theta^f}{\varepsilon^f}\right)+c^w.$$

Equation (12) can be used in conjunction with the inverse farm supply curve S(Q) to yield the inverse derived supply curve, $P^w = S^w(Q{*}2^f_{,}\, c^w)$.

A representative retailer's profit function can be expressed as

(13) $$\pi^r = D(Q)q - S^w(Q)q - c^r q.$$

The first order condition for maximizing equation (13) is

(14) $$P^r\left(1-\frac{\xi^r}{\eta^r}\right)= P^w\left(1+\frac{\theta^w}{\varepsilon^w}\right)+c^r.$$

Market equilibrium for this subcase is defined by equations (1), (2), (12), and (14).

By focusing directly on the end product of oligopoly/oligopsony power, as measured by the > and 2 parameters, we need not be concerned with particular market structures or oligopoly/oligopsony games. This makes the model a very convenient tool for conducting simulations. However, to provide a realistic basis to parameterize the simulation model, we first examine and evaluate some of the accumulated evidence on market power in the U.S. food system.

## Empirical Evidence on Market Power in the US Food System

We do not attempt to provide an exhaustive survey of empirical analyses of market power in food processing and distribution, focusing instead on some key industries or sectors that have been the objects of several studies and on key issues pertaining to this body of work.

Beef packing. The U.S. beef sector has been the object of particularly frequent attention due to the dramatic rise in seller and buyer concentration. Congress in 1992 commissioned the USDA to investigate the effects of concentration in the industry. This study alone resulted in seven technical reports which are summarized in USDA (1996).[3] The rise in concentration in beef packing was fueled at least partially by technological change. During the 1960s the boxed-beef technology was introduced, wherein carcasses were processed into individual cuts, packed, and shipped from the same plant where slaughter took place. This capital-intensive technology resulted in expanded economies of size in the industry. In addition, declining consumption of red meats led to excess capacity, triggering a wave of mergers and acquisitions during the 1970s and 1980s [Purcell, (1990)]. In 1977, the four leading packers were estimated to hold 30 percent of total slaughter capacity. By 1992, the four-firm concentration ratio (CR4) was estimated at 82 percent.

Studies of the beef packing sector conducted within the structure-conduct-

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[3]Among the technical reports is a detailed survey of research on the competitiveness of the US meat packing industry by Azzam and Anderson (1996).

performance (SCP) framework include Menkhaus, St. Clair, and Ahmaddaud (1981), Quail et al. (1986), and Marion and Geithman (1995). These studies found a negative relationship between concentration (generally measured as the CR4) and the price paid to ranchers and a positive correlation between feedlot size and price received, suggesting possible countervailing power. Ward (1981, 1982, 1988, and 1992) pioneered the use of transactions price data to examine the determinants of fed cattle prices. In both Ward (1981) and (1992) feedlot prices are positively correlated with the number of buyers bidding for the purchase. The Texas A&M Agricultural Market Research Center (1996), however, found only a weak effect on fed cattle price for a regional Herfindahl index variable.

Using a structural model in the evolving tradition of the new empirical industrial organization (NEIO) and a sample period from 1951-83, Schroeter (1988) rejected price-taking behavior but found that distortions from competitive pricing were modest in magnitude--on the order of 3 percent in output sales and 1 percent in input purchases. Several extensions of this work followed soon thereafter. Azzam and Pagoulatos (1990) studied meat packing as an aggregate industry. Through their production function formulation they were able to obtain point estimates of conjectural elasticities of both oligopoly power (>= 0.223) and oligopsony power (2= 0.178). Schroeter and Azzam (1990) developed a multiproduct model of the meat packing industry, treating pork and beef as separate products, but not allowing oligopoly and oligopsony conjectures to differ. This study also rejected price taking behavior, although the estimated $\theta = \xi$ parameters were small in magnitude. Azzam (1992) rejected price taking behavior by U.S. beef packers in farm product purchases but not in processed product sales.

More recent tests of beef packer market power include Muth (1996), who analyzes oligopoly power, and Kambhampaty et al. (1996) and Muth and Wohlgenant (1999), who analyze oligopsony power. Muth and Muth and Wohlgenant fail to find any evidence of market power in contrast to the majority of prior studies. They attribute the different results to the prior authors' assumption of a fixed proportions and constant returns processing technology. Kambhampaty et al. treated the conjectural elasticity/farm product supply elasticity ratio ($2/\varepsilon$) as a single parameter. This parameter was positive and significant in the estimation, but other estimated parameters did not comport with economic theory.

<u>Fruits and Vegetables.</u> Just and Chern's (1980) analysis of oligopsony power in the California tomato processing industry was the first application of the comparative statics approach, exposited more generally by Breshnahan (1982), to testing for market power. Just and Chern argued that substitution of a fixed capital input (the mechanical harvester) in place of a variable input (farm labor) made farm supply less elastic, offering a natural experiment wherein a competitive market's response could be distinguished from the response of a market with oligopsony power. Whereas the competitive model predicts unambiguously that the supply shift will lead to greater production of the farm product, the effect is ambiguous in the oligopsony model. Empirical results supported the oligopsony model's prediction. The industry was later analyzed by Durham and Sexton (1992), who estimated residual supply elasticities for six production and

processing regions in California. The estimated elasticities were large, ranging from 8.6 to essentially infinity, which caused the authors to conclude that oligopsony potential in the industry was limited. Structural changes in the industry since the time of the Just and Chern analysis may account for the different conclusions about competitiveness.[4]

Applications of conjectural variations models include Wann and Sexton (1992) to U.S. pear processing, Taylor and Kilmer (1988) to Florida celery, and several studies of behavior under U.S. marketing orders. Estimates from Wann and Sexton's multiple product framework suggested limited oligopoly power in pear processing (> = 0.08), but greater power in the sale of fruit cocktail (> = 0.48). Hypotheses of perfect competition and pure monopsony in pear procurement were both rejected. Florida celery is marketed through a single cooperative supported by a federal marketing order. Taylor and Kilmer investigated whether this organization was able to exercise market power. Estimation results found modest (> 0 [0.03, 0.15]) and insignificant levels of oligopoly power.[5]

Dairy. Masson and Eisenstat (1980) estimated that U.S. dairy cooperatives succeeded in raising retail fluid milk prices by $0.07 - $0.10 per gallon (3.78 liters) with an annual loss to consumers of $71 million from 1967-1975, before their

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[4] A dominant processor during the time of the Just and Chern study had since seen its share erode, a grower bargaining association had arisen to prominence, and longer hauls may have stimulated greater interregional competition.

[5] This result is consistent with the observation that Florida is a relatively minor player in celery sales in the U.S. In most metropolitan areas and in most months, most sales are from California, where marketing is not coordinated [Sexton, Kling, and Carman, (1991)].

alleged anticompetitive behavior was halted by antitrust action. A subsequent study by Madhavan, Masson, and Lesser (1994) focused on the monopoly power of a single cooperative, the Associated Milk Producers, Inc., and concluded that it was able to raise margins by $0.026 per gallon prior to the 1975 consent decree.[6] Suzuki et al. (1994) exploited observed price differentials between fluid and manufacturing milk to derive nonparametric estimates of the U.S. dairy cooperatives' market power. The manufacturing milk price plays the role of a competitive benchmark framework in this study. The imputed > values ranged from 0.06 to 0.08. Liu, Sun, and Kaiser (1995) estimated mean values of $\theta$ equal to 0.10 and 0.18 for U.S. dairy processors in manufacturing and fluid milk respectively.

<u>Grocery retailing.</u> Rising concentration and consolidation of sales among large supermarket chains and supercenters in the U.S. have made retailer market power in the food industry a topical issue. Food retailing is not amenable to the application of NEIO methods because it involves the production and sale of a vast number of different products--an average of 30,000 different items for U.S. supermarkets.[7] SCP methods are, however, useful because prices can be observed

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[6]Baumer, Masson, and Masson (1986) argued that the monopoly power needed in US milk markets to exercise price discrimination over and above that mandated through US marketing orders was caused by a wave of mergers among milk marketing cooperatives during the 1960s. The mergers were not challenged in the belief that they were protected under the Capper-Volstead Act.

[7]Hyde and Perloff's (1998) study of market power in the Australian meat sector is an attempt to apply NEIO methods to measure grocer market power. They avoided issues of the multiproduct technology by using simple linear marginal cost specifications for each meat product studied, implicitly assuming that the unspecified cost function is strongly separable.

readily and aggregated into indices. Data are also often available on the explanatory variables that might be utilized within the loose theoretical structure of the SCP paradigm to account for demand- and cost-side determinants of price. Studies such as Hall, Schmitz, and Cothern (1979), Lamm (1981), Newmark (1990), Marion, Heimforth, and Bailey (1993), and Binkley and Connor (1998) have examined average retail price relationships using cities as the unit of observation.

Cotterill (1986), Kaufman and Handy (1989), and Cotterill and Harper (1995) focused upon the behavior of individual stores, giving them the opportunity for increased precision and relevance in construction and use of explanatory variables relative to earlier studies. Cotterill (1986) studied food retailer monopoly power in Vermont, a sparsely populated state which provided an almost ideal setting to delineate relevant geographic markets for identifying concentration.[8] Concentration variables (CR4, CR1, or the Herfindahl index) were positively associated with price and statistically significant. A parallel study of Arkansas supermarkets by Cotterill and Harper (1995) reached similar conclusions as to the impacts of retailer concentration on food prices.[9]

However, not all studies of grocery retailing have found a positive association between concentration and price. Kaufman and Handy (1989) studied 616 supermarkets chosen from 28 cities selected at random. Both firm market

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[8]This geographic isolation has, ironically, been the primary basis to criticize the study on the grounds that the very high levels of concentration observed are atypical.

[9]Studies conducted at the city level which have found a positive structure-price relationship include Hall, Schmitz, and Cothern (1979), Lamm (1981), and Marion, Heimforth, and Bailey (1993).

share and a four-firm Herfindahl index were negatively but insignificantly correlated with price. Newmark (1990) also obtained a negative and insignificant coefficient on CR4 in a study of the price of a market basket of goods for 27 cities. However, Newmark's conclusions have been questioned in recent work by Yu and Connor (2000). Cotterill (1993) part 5 contains a debate on the issue of market power in grocery retailing, including a critique of the Kaufman-Handy study and response by the authors.[10]

*Evaluation of the Empirical Work*

What have we learned from the various empirical studies of market power in agriculture? First, in highly concentrated industries, a positive (negative) correlation between concentration and selling (purchasing) price exists. This correlation has been found rather consistently across many SCP studies of food processor oligopoly and oligopsony power and food retailer oligopoly power.

The NEIO studies of processor behavior have generally found some statistical evidence of market power, although the measured departures from competition have mostly been small, with point estimates of $\theta$ or $\xi$ often being less than 0.2 (the market power equivalent of that produced in a five firm symmetric Cournot equilibrium). Because these studies have naturally been conducted in industries where structural conditions suggest the possible presence of market

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[10]Binkley and Connor (1998) suggest one explanation for the conflicting results in terms of the product coverage in the price variable. They found a positive and significant concentration-price correlation for dry groceries and a negative and insignificant correlation for fresh and chilled food

power, these results on the whole suggest that market power has, in the past, not been a very important factor in the food processing sector.

Various criticisms can be levelled against both bodies of work. The most well known are the critiques of the SCP studies. These include the Demsetz (1973) critique of the interpretation of profit-structure studies and Fisher and McGowan's (1983) critique of the use of accounting data to infer market power. Although responses to these critiques can and have been made, the drift of the SCP literature away from studies of profits and to the analysis of price-structure relationships within a single industry is appropriate.[11] In our view, studies of the price-structure relationship, such as Cotterill (1986), that focus on a single industry and control effectively for factors besides structure that may influence price provide some of the most convincing evidence of market power in the food chain. Nonetheless, a modified version of the Demsetz critique has been levelled against the SCP studies of price based on a quality argument. According to this reasoning, the most successful firms provide the best quality products and related service, thereby receiving price premiums or paying discounted prices and attaining large market shares. For example, in the context of the beef sector studies, it might be argued that large buyers offer better service than small buyers (e.g., prompt and reliable payment, secure market outlet, technical assistance) thereby enabling them to pay lower prices. A similar argument can be constructed

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items.

[11]A good source for the debate between the SCP analysts and their critics is Part Five of Cotterill (1993).

for why large sellers may earn price premiums.

Perhaps due to their more recent vintage, there has been less formal criticism of the NEIO studies, although some criticisms of the SCP studies (e.g., Fisher and McGowan (1983)) apply equally to NEIO studies [Cotterill, (1993)]. One aspect that has been discussed critically has been the conceptual underpinning or lack thereof provided by the conjectural variations framework. Conjectural variations attempt to model a dynamic phenomenon (i.e., action and reaction) within a static framework. An example of this problem is the tendency of the conjectured behavior to fail to coincide with rivals' actual optimal response. As it pertains to the theory, the profession has moved to address dynamic interactions with explicitly dynamic models. As to empirical work, recent practice has been to specify first-order conditions such as (6') without any direct reference to $\theta$ or $\xi$ representing conjectural variations. They are simply empirical indices that measure the departure of a given market from competitive outcomes. Recent work by Corts (1998), however, casts doubt upon this interpretation. Corts shows that empirical estimates of 2 or > are generally incapable of measuring the underlying market power in an industry unless, in fact, the data used in the estimation represent equilibria from a market in which the firms do behave in accord with a conjectural variations model.

Two additional general criticisms can be levelled against empirical work on the food and beverage industries conducted within the NEIO framework. The first is that essentially all of the studies have relied on maintained functional forms for market demand and/or supply and processor technology. The researcher is, thus, always testing a joint hypothesis--whatever is intended to be tested plus the maintained hypothesis of functional form. This criticism applies, of course, not just to studies of market power and is the launching point for nonparametric analyses of demand, production, and market power.[12] The problem is mitigated partially when the researcher utilizes flexible functional forms. In NEIO studies, the processing technology is often represented by such functions, but retail or wholesale demand and/or farm supply are usually represented by simple linear or double log functions, or else the needed elasticities are obtained from extraneous estimates.

Even more vexing is the issue of technical change in food processing. Most applications of the NEIO models proceed with annual data at the industry level. In order to obtain sufficient observations, these applications may study 30 or more years of industry data, during which time significant technical change will almost inevitably have occurred. NEIO studies have addressed technological change, if at all, through very simple means such as time trends. Incorporating more sophisticated methods is not necessarily straightforward because of data limitations and convergence problems in the highly nonlinear empirical models.

Another dimension of the functional-form argument that arises mainly in agricultural applications concerns the elasticity of substitution, $\sigma$, between the farm input and other inputs in producing a finished product. Most authors have assumed that no such substitution exists, whereas others such as Gardner

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[12] See Ashenfelter and Sullivan (1987) and Love and Shumway (1994) for applications of the nonparametric

(1975), Wohlgenant (1989), and Holloway (1991) have considered substitution possibilities to be an integral part of agricultural market models. Muth (1996) and Muth and Wohlgenant (1999) have attributed several authors' empirical finding of market power in the beef industry in part to their failure to allow for substitution in their model frameworks.

A second general criticism of the NEIO studies has been their architects' failure in many cases to think carefully about the markets they intend to analyze before conducting the actual analysis. Antitrust actions that evolve around market power begin with definitions of the relevant market, both in geographic and in product form dimensions. Only when these issues are settled does the action proceed to assess the actual exercise of market power. This sequence is fundamental to studying market power. Of what relevance is it to ask whether a firm or group of firms exercises market power without having first answered what are the relevant geographic and product markets within which the firms operate? Most NEIO applications in agriculture have treated market definition issues superficially at best. The work on meats provides examples of the problem. Some applications have studied meat packing in aggregate. Others have focused on specific meats. Despite evidence that cattle are seldom shipped as far as 300 miles, various studies have investigated packer oligopsony power using data aggregated to the national level, without questioning whether the relevant geographic markets are regional in scope.

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approach to examining oligopoly power and oligopsony power, respectively.

A factor contributing to poorly defined product or geographic markets is that many NEIO and aggregate SCP studies use data collected for reasons other than economic analysis such as the U.S. SIC data. Data at the digit level of aggregation in the four-digit SIC codes often contain a variety of products which are mostly linked through a common agricultural input, not by end use. For example, SIC 2015 is poultry and egg processing, and Bhuyan and Lopez (1997) found moderate oligopoly power ($\theta = 0.289$) in this category for the period 1972-87. Five-digit SIC categories within SIC 2015 include young chickens, turkeys, other poultry, and liquid, dried, and frozen eggs. Other examples of empirical analyses of market power that clearly have failed to define relevant markets include Holloway (1991) and more recently Reed and Clark (2000), where processed fruits and vegetables, fresh fruit, and fresh vegetables are among the "markets" studied.

A related concern is the tendency of the NEIO studies to investigate processor oligopoly or oligopsony power on one side of the market while maintaining an assumption of perfect competition on the other side of the market.[13] Although there may be good economic rationale for this decision, often there is not because structural bases for concern about oligopoly power usually imply parallel concerns about oligopsony power and vice versa. How does an erroneous assumption about competition on one side of the market affect inferences about market power on the other side of the market?

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[13] An alternative approach has been to assume that market power is identical in both the farm product and finished product markets, i.e., 2 = > [Schroeter (1988) and Schroeter and Azzam (1990)]. Because of likely differences in the relevant geographic and product markets for the farm product versus the finished product, this practice also has

More research is needed on the implications of the various maintained hypotheses for our ability to draw inferences about market power. Additional Monte Carlo studies along the lines of Hyde and Perloff (1994) and Raper, Love, and Shumway (1998) could help to answer these questions. Also helpful will be more studies patterned after Genesove and Mullin (1998), who utilized cost and price data and a demand elasticity estimate for the U.S. cane sugar industry to compute a direct estimate of > using a mark-up relationship like (8N). Estimates of > derived from alternative NEIO approaches were then compared to the "true" value and were found to comport quite closely and to be insensitive to the functional form of demand.

**Welfare Losses From Market Power in the US Food System**

How do estimates of market power translate into measures of social loss and loss to consumers? Measuring static welfare loss from seller market power is not difficult conceptually. Given the volume of output, Q*, in an industry, one needs to obtain an estimate of the markup of price over cost and an estimate of the elasticity of demand in the market in order to compute the deadweight loss or "Harberger" triangle. In Figure 1, this is the area B, given retail demand $D_1(Q)$ and the area B+C, given demand $D_o(Q)$. An immediate issue is whether to also include the rectangle A of profits in Figure 4 transferred to the monopolist/oligopolists (the so-called Posner (1975) rectangle). The various arguments in support of including

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limitations. Azzam and Pagoulatos (1990) and Wann and Sexton (1992) present two alternative approaches that the rectangle are that monopoly power encourages resource waste or X-inefficiency and wasteful expenditures such as advertising and lobbying to achieve and maintain the monopoly position and that these costs can be approximated by the profit rectangle.

Parker and Connor (PC 1979) estimated welfare losses in each U.S. food manufacturing industry by first estimating SCP models of the price-cost margin and then using fitted values from the estimation to calculate the monopoly overcharge in each industry. PC produced loss estimates including the Posner rectangle of about 5.7 percent of U.S. food expenditures in 1975. In contrast to the empirical approach of PC, Gisser (1982) generated welfare loss estimates from a conceptual oligopoly model that assumed 36 percent of firms in an industry acted as collusive price leaders and the remaining 64 percent operated as a competitive price-taking fringe.[14] He adduced gross losses including the Posner rectangle similar to those of PC. However, Gisser also analyzed the determinants of factor productivity in food manufacturing and found it to be positively associated with increases in food industry concentration. Incorporating these cost savings into the welfare analysis caused the welfare losses due to oligopoly power to disappear. Young (1997) provides a detailed critique of the use of the dominant firm price leadership model to estimate welfare loss.

Recent welfare loss studies for the U.S. food sector include Bhuyan and

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allow 2 and > to differ within a vertical market.

[14]The justification for this assumption was that 36% was the weighted CR4 in food manufacturing for 1972. As noted, the comparable figure for 1992 was 53.3%.

Lopez (1995) and Peterson and Connor (1996). Peterson and Connor utilized results from a study of brand name versus private label price differences in food manufacturing by Connor and Peterson (1992) to estimate price-cost margins in each industry from which the Harberger triangle and the Posner rectangle were computed.[15] Losses on average were 6.9 percent of the value of 1979-80 food shipments.[16] Bhuyan and Lopez (1995) inferred a value of > for each U.S. food manufacturing industry from published data on industry sales and costs. Given additional data on elasticity of demand in each industry from a study by Pagoulatos and Sorensen (1986) and the Herfindahl index and an assumption of constant marginal production costs, they then estimated the resulting welfare loss in terms of the Harberger triangle only. They pegged the average loss at 3 percent of total sales for 1987, with nearly 40 percent of that loss coming from the tobacco industries alone.

Given that no consensus has been reached on the importance of market power in the food system, it is not surprising that little agreement exists on the welfare costs of market power. An important difference among analysts concerns market power's effect on costs. Some believe market power breeds inefficiency and waste and, thus, justifies inclusion of Posner's rectangle as a welfare loss. Others

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[15]The premise underlying this approach is that the private label market is competitive, so that the private label price equals marginal cost. If this premise is correct and if private label production costs are the same as brand products' production costs, then the price difference between a branded product and its private label counterpart will represent the oligopoly mark up.

[16]The key measure of concentration in Connor and Peterson (1992), the Herfindahl index divided by the industry elasticity of demand, was subsequently found to have the erroneous sign (Hinloopen and Martin 1997). The loss estimate reported here is based on the correct sign.

of a Chicago School persuasion, such as Gisser, believe market power is mostly efficiency driven and, thus, those benefits must be measured and weighed against the costs of any supracompetitive pricing.

The demand elasticity also plays a crucial role in studies such as Gisser (1982) or Bhuyan and Lopez (1995) that derive the price-cost margin from a structural oligopoly model rather than by estimating it from an SCP regression. Under the latter methodology the elasticity plays only a minor role in calculating the Harberger triangle, *given* the estimated price-cost margin, as in the area B versus the area B+C in Figure 1. In the structural models, the imputed elasticity value is crucial to *deriving* the price-cost markup, given the assumed mode of oligopoly behavior— e.g., see equation (6N). Notably absent from the literature are studies which attempt to measure welfare losses due to the buying and selling power of food retailers or to the power of food processors as buyers of farm products. Our subsequent simulation analysis gives a sense of possible welfare losses when market power is present at multiple stages of an industry.

Overall, this body of work is too ambitious in attempting to apply the same set of methods, whether SCP paradigm or structural, across many, diverse industries. Studies that focus on the welfare implications of market power in individual industries are likely to yield more accurate indications of the welfare costs of market power. Recent examples include work by Azzam and Schroeter (1995) and Azzam (1997) on the tradeoff between efficiency gains and oligopsony power losses from consolidation in the U.S. beef industry, and Triffin and Dawson (1997) on the losses from oligopoly in frozen potato products in the U.K. For example, Azzam

(1997) estimated that oligopsony power increased with rising concentration in beef packing but that the costs of market power were more than offset by the reduction in packing costs due to economies of size.

**Simulation Analysis**

Because no empirical studies have evaluated the welfare consequences of both oligopoly and oligopsony power or of successive oligopoly/oligopsony in a food market, simulation analysis can play a useful role in indicating the potential welfare implications of such market behavior. To conduct simulations, it is necessary to assign specific functional forms for the retail demand and farm supply functions specified in general form in equations (1) and (2). We chose linear models for this purpose:

(1') $Q^r = a - \alpha P^r$, retail demand,

(2') $P^f = b + \beta Q^f$, inverse farm supply.

In addition, we invoke the normalizations that are available without loss of generality by choosing units so that the quantity and retail price in competitive equilibrium, ($Q_c$, $P_c^r$), are both unity: $Q_c = 1$, $P_c^r = 1$, in which case $P_c^w = 1 - c^r$, $P_c^f = 1 - c^r - c^w = f$, where f is farmers' revenue share under perfect competition. Given the normalizations, the following relationships among the model's parameters are readily derived:

(15) $$\alpha = \eta_c^r, \quad \beta = \frac{f}{\varepsilon_c^f}, \quad a = 1 + \alpha, \quad b = f - \beta,$$

where $\eta_c^r$ is the absolute value of retail price elasticity of demand and $\varepsilon_c^f$ is the price elasticity of farm supply elasticity, both evaluated at the competitive equilibrium. Given the linear model, economic welfare under perfect competition is apportioned among the market participants as follows:

$$(16) \qquad CS_c = \int_{P_c^r}^{a/\alpha} (a - \alpha P)dP = \frac{1}{2\alpha} = \frac{1}{2\eta_c^r}, \quad \text{consumer surplus,}$$

$$(17) \qquad PS_c = \int_{b}^{P_c^f} \frac{P-b}{\beta} dP = \frac{\beta}{2} = \frac{f}{2\varepsilon_c^f}, \quad \text{producer surplus ,}$$

$$(18) \qquad \Pi_c = 0, \quad \text{processor + retailer profit.}$$

Total social benefit is maximized under perfect competition and is computed as follows:

$$SB_c = PS_c + CS_c = \frac{1+\alpha\beta}{2\alpha}.$$

Given $P^r = P^w + c^r$ under competitive retailer behavior, we can solve (1'), (2'), and (6') simultaneously to obtain the following equilibrium solutions for the linear model when the processing sector is imperfectly competitive:

$$(19) \qquad Q_1 = \frac{1+\alpha\beta}{\Omega_1}, \quad P_1^w = \frac{a - Q_1}{\alpha} - c^r, \quad P_1^r = P_1^w + c^r, \quad P_1^f = b + \beta Q_1,$$

where $\Omega_1 = (1+\xi^w) + (1+\theta^f)\alpha\beta = (1+\xi^w) + (1+\theta^f)f\phi_c$, and $\phi_c = \eta_c^r / \varepsilon_c^f$ is the ratio of the retail demand elasticity to the farm supply elasticity, evaluated at the competitive equilibrium. The expression $\Sigma_1$ measures the total distortion due to oligopoly and oligopsony power, and $Q_1 < 1 = Q_c$ whenever either $2^f$ or $>^w$ is positive. Figure 2 illustrates the model.[17]

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[17] Figures 2-4 rely on Melnick and Shalit's (1985) observation that an industry with oligopoly power acts as if it faces a perceived marginal revenue (PMR) curve that consists of a linear combination of the marginal revenue curve, $\partial[D(Q)Q]/\partial Q$, and the market demand curve, D(Q), with > representing the weight attributed to the marginal revenue curve and (1->) representing the weight attributed to the demand curve. Similarly, for an industry with oligopsony power, the perceived marginal factor cost curve is 2MC(Q) + (1-2)S(Q), where MC = M[S(Q)Q]/MQ denotes the marginal factor cost curve.

Economic surplus under processor *or* retailer market power is distributed as follows:

(20) $$CS_1 = \int_{P_1^r}^{a/\alpha} (a - \alpha P)dP = \frac{(a - \alpha P_1^r)^2}{2\alpha},$$

(21) $$PS_c = \int_b^{P_1^f} \frac{P - b}{\beta} dP = \frac{(P_1^f - b)^2}{2\beta},$$

(22) $$\Pi_1 = \Pi_1^w + \Pi_1^r = (P_1^r - P_1^f - 1 + f)Q_1.$$

In this model, the market equilibrium prices and output and distribution of economic welfare are determined solely by four market parameters: $\xi^w$ (seller oligopoly power), $\theta^f$ (buyer oligopsony power), $\phi$ (ratio of the elasticity of retail demand to farm supply) and f (farm revenue share under perfect competition). The equilibrium output, farm price, retail price, and distribution of welfare among producers, marketers, and consumers are identical if the same magnitudes of market power are exercised by the retail sector instead of the manufacturing sector. These same results also hold for the rather plausible case where processors exercise oligopsony power over farmers and retailers exercise oligopoly power over consumers, but the interactions between processors and retailers are conducted under conditions of perfect competition.

For the linear version of the model with successive oligopoly power, the market equilibrium is defined by equations (1'), (2'), (8), and (10):

$$Q_2 = \frac{1 + \alpha\beta}{\Omega_2}, \quad P_2^w = b + \beta Q_2 + c^w, \quad P_2^r = \frac{a - Q_2}{\alpha}, \quad P_2^f = b + \beta Q_2,$$

where $\Omega_2 = (1 + \xi^r)(1 + \xi^w) + (1 + \theta^f)\alpha\beta = (1 + \xi^r)(1 + \xi^w) + (1 + \theta^f)f\phi$. In this case the market equilibrium and welfare distribution are determined by five parameters: $\xi^r$, $\xi^w$, $\theta^f$, $\phi$, and f. In addition to the parameters contained in case I, a second > parameter reflects the degree of seller market power at successive stages of the market chain. Figure 3 illustrates this scenario. The curve $P^w = PMR^r - c^r$ in Figures 3 and 4 represents the retail sector's derived demand for the farm product at the wholesale level, given the retailers' oligopoly power—see footnote 17. The reduction in output from $Q_1$ to $Q_2$ in Figure 3 represents the incremental distortion to output from successive oligopoly power.

Finally, the market equilibrium with successive oligopsony power is defined for the linear version of the model by equations (1'), (2'), (12) and (14). Solving the system yields the following solutions for the endogenous variables:

$$Q_3 = \frac{1+\alpha\beta}{\Omega_3}, \quad P_3^w = b + \beta Q_3 + c^w, \quad P_3^r = \frac{a - Q_3}{\alpha}, \quad P_3^f = b + \beta Q_3,$$

where $\Omega_3 = (1+\xi^r) + (1+\theta^f)(1+\theta^w)\alpha\beta = (1+\xi^r) + (1+\theta^f)(1+\theta^w)f\phi$. The market equilibrium and welfare distribution are determined by five parameters: $\xi^r$, $\theta^w$, $\theta^f$, $\phi$, and f, with the fifth parameter in this subcase reflecting the possibility of oligopsony power at successive stages. The successive oligopsony case is illustrated in Figure 4, where the reduction in output from $Q_1$ to $Q_3$ represents the incremental distortion in output due to successive oligopsony power.

In structuring the simulation, the parameter f, the farm share of revenue under perfect competition was fixed at either f = 0.5, i.e., a 50% farm share or f = 0.2. A 50% farm share is roughly reflective of the situation for some meat and dairy products and eggs, while a 20% share is reflective of both fresh and processed fruit and vegetable markets. The primary effect of f in the model is to influence the importance of oligopsony power on output and consumer welfare in the market. When f is small, the farm input is not an important determinant of the final product value, and, thus, oligopsony power in the farm sector has only a minor impact on total market output and consumer welfare.

The farm supply and retail demand elasticities always affect the market equilibrium and the distribution of welfare in the relative form N = 0/,, enabling the simulation to focus solely on alternative values for N. In considering values of N for the simulation, note that in many cases both retail demand and farm supply for a food product are rather inelastic, suggesting that the ratio of the elasticities will often be near unity. We treat N = 1 as a base value, and also consider values of N = 0.5 (demand is less elastic than supply) and N = 2 (demand is more elastic than supply). In all cases, the values of the elasticities are set at the competitive equilibrium, which is always set via normalization to be $P_c^r = 1, Q_c = 1$. Given the linear formulations for retail supply and farm demand, the elasticities change as one moves along the curves to identify alternative forms of imperfectly competitive equilibria. However, the relative magnitudes of alternative elasticity specifications are the same across the various equilibria to be explored in the simulations.

The most important parameters for the purposes of the simulation analysis are the market power parameters, 2 and >, which both range in the unit interval. As noted, most point estimates of 2 and/or > from prior empirical studies have been 0.2 or less. Bhuyan and Lopez's (1997) ambitious attempt to estimate > values for all four digit SIC food and beverage industries, however, yielded somewhat higher point estimates, with some categories (i.e., 2043 cereal preparation, 2041 flour & grain mills, 2075 soybean oil mills) yielding estimates of > of about 0.5. Given the rapid increase in consolidation of both food manufacturing and retailing, the past studies may understate current levels of market power.

Given a base value of f = 0.5, Figure 5 illustrates the percent loss in consumer surplus from processor or retailer oligopoly power only, while Figure 6 provides comparable information for the case of processor or retailer oligopsony power only. Each figure illustrates results for $N_c$ , {0.5, 1.0, 2.0}. Higher values of N indicate a retail demand that is elastic relative to the farm supply. Figure 5 shows that even the modest exercise of oligopoly power as manifest by > = 0.2, causes a reduction in consumer surplus relative to the competitive outcome ranging from 17% (N = 2) to 26% (N = 0.5), with the loss being larger the more inelastic is the consumer demand relative to the farm supply. Market power in the magnitude of > = 0.5 (e.g., a Cournot duopoly) results in consumer surplus losses ranging from 36% (N = 2) to 49% (N = 0.5).

The impact of oligopsony power on consumers is less severe because the farm product comprises only part of the final product's value. Figure 6 illustrates the case of f = 0.5. Modest oligopsony power as manifest by 2 = 0.2 results in a loss of consumer surplus ranging from 7.5% (N = 0.5) to 17% (N = 2.0). With oligopsony, the loss to consumers from given 2 is magnified the more inelastic is farm supply relative to retail demand because the distortion to output is greater the more inelastic the supply. For situations where 2 = 0.50 (e.g., a Cournot duopsony), the loss to consumers ranges from 17% (N = 0.5) to 36% (N = 2.0).

These simulations are roughly reflective of meat and egg markets where the farm revenue share is rather large. The impact declines as f declines. For the case where f = 0.2, reflective of many fruit and vegetable markets, the consumer loss from 2 = 0.2 ranges from 3.5% (N = 0.5) to 10.5% (N = 2.0), and the loss from 2 = 0.5 ranges from 8.5% to 23%.

Further perspective on the impact of food sector market power on consumers is provided in Figure 7. Focusing on the case when N = 1, Figure 7 compares the percentage reduction in consumer surplus relative to the competitive outcome from oligopoly and oligopsony power only and from joint oligopoly and oligopsony power. The impact of a given level of oligopoly power is more severe than the equivalent exercise of oligopsony power, and when both types of market power are present, the losses to consumers are compounded. Modest oligopoly and oligopsony power of the magnitude 2 = > = 0.2 causes consumer welfare to fall by 31% relative to the competitive outcome in the base simulation, while 2 = > = 0.5 results in consumer welfare that is 56% less than under perfect competition.

Figure 8 illustrates total welfare and Figure 9 indicates the distribution of welfare among farmers, marketers and consumers for the oligopoly only, oligopsony only, and both oligopoly and oligopsony scenarios discussed in Figure 7. Jointly, Figures 8 and 9 indicate that the impacts of modest levels of market power are primarily distributional. For f = 0.5 and N = 1, The percentage reduction in total welfare relative to competitive solution is only 0.4% for 2 = 0.2 and > = 0, 1.4% for, 2 = 0 and > = 0.2, and 2.8% for > = 2 = 0.2. Given this same scenario and perfect competition, consumers capture 2/3 of the total welfare in the market and producers capture the other 1/3. Under oligopoly power only (> = 0.2) the distribution of surplus from the market becomes consumers 53%, producers 26%, and marketers 21%. Under only oligopsony (2 = 0.2), the distribution is consumers 59%, producers 29%, and marketers 12%. Under both oligopoly and oligopsony (2 = > = 0.2), marketers capture 29% of the total surplus, compared to 48% for consumers and 24% for producers.

As Figure 8 illustrates, the percent deadweight loss increases at an increasing rate as a function of 2 and >. For > = 0.5, the deadweight loss is 6.25%, while for 2 = 0.5, it is 2.0% percent. For 2 = > = 0.5, the deadweight loss escalates to 11.1%. The effects on distribution from market power of this order of magnitude are even more pronounced. For > = 0.5, the distribution is 40% for consumers, 20% for producers, and 40% for marketers. For 2 = 0.5, the distribution is 50% consumers, 25% producers, and 25% marketers. When marketers hold both oligopoly and oligopsony power on this order of magnitude, the distribution of benefits is 1/3 for consumers, 1/6 for producers, and 1/2 for marketers. As we have shown in other work [Alston, Sexton, and Zhang (1997), Sexton and Zhang (2000)], this same pattern of distributional effects also applies to benefits generated from industry initiatives for research, promotion, etc. when markets are imperfectly competitive.

*Successive Oligopoly/Oligopsony*

Figures 10-13 summarize behavior for a food industry that is characterized by successive oligopoly or oligopsony power. Figure 10 examines losses to consumers for the base case where f = 0.5 and N = 1. A modest exercise of successive oligopoly power in conjunction with processor oligopsony power, as characterized by $>^w = >^r = 2^f = 0.2$ reduces consumer surplus by nearly half (46%) relative to the competitive outcome. The impact of the comparable case of successive oligopsony power in conjunction with retailer oligopoly power, $2^f = 2^w = >^r = 0.2$, is somewhat less severe, generating a consumer surplus loss of 39%. If successive oligopoly power rises to the level of Cournot duopoly/duopsony, i.e., $>^{w} = >^{r} = 2^{f} = 0.5$, consumer surplus is reduced by fully 75% from its level at the competitive benchmark, with the comparable successive oligopsony case, $2^{f} = 2^{w} = >^{r} = 0.5$, reducing consumer surplus by two-thirds relative to perfect competition.

Figure 11 indicates the magnitude of deadweight losses under successive oligopoly or oligopsony. The modest exercise of successive oligopoly power, $>^{w} = >^{r} = 2^{f} = 0.2$, induces a deadweight loss of 7%. When $>^{w} = >^{r} = 2^{f} = 0.5$, the deadweight loss rises to 25%, again reflecting that deadweight loss rises at an increasing rate as a function of the degree of market power exercised. Deadweight losses are more modest under successive oligopsony—4.8% for $2^{f} = 2^{w} = >^{r} = 0.2$ and 18.4% for $2^{f} = 2^{w} = >^{r} = 0.5$.

Figure 12 provides information on the distribution of benefits in the market under successive oligopoly power for the base case where f = 0.5 and N =1, while Figure 13 provides the same information for the successive oligopsony case. Modest market power, when it is distributed throughout the marketing sector, as manifest by the case of $>^{w} = >^{r} = 2^{f} = 0.2$, enables the marketing sector to capture the plurality of benefits from production and sale of the product: 42%, versus 39% for consumers and 19% for producers. (Recall that, given the set up of the model, marketers capture no surplus under perfect competition.) If successive oligopoly power should rise to the level represented by $>^{w} = >^{r} = 2^{f} = 0.5$, marketers would capture fully two-thirds of the surplus in the market, relegating consumers and farmers to shares of two-ninth and one ninth respectively.

The impacts on distribution of successive oligopsony power are somewhat less severe. The case of $2^{f} = 2^{w} = >^{r} = 0.2$ results in a distribution of benefits of 43% for consumers, 36% for marketers, and 21% for farmers. Marketers share rises to 60% for $2^f = 2^w = >^r = 0.5$, with 27% going to consumers and 13% to producers.

**Conclusions**

This paper has studied the impact of market power on behavior and economic welfare in a prototype food market. Rapid consolidation among firms in all sectors of food marketing has heightened concerns that these marketing firms are exercising market power to the detriment of producers and consumers. We developed a simple but flexible model of a food market that is capable of representing alternative levels of retailer oligopoly power, manufacturer oligopsony power, and successive oligopoly or oligopsony power. We formulated a linear version of the general model for purposes of conducting simulation analyses.

Simulations are useful given the rather unclear picture that has emerged from the considerable empirical work conducted to date on market power in the food sector. Because most empirical analyses have investigated market power at a single stage within the market channel, e.g., food manufacturing, little is known about the behavioral and welfare impacts when market power exists throughout the channel. The simulation analyses reported here showed how even modest levels of market power, when exercised at multiple stages of the market channel, can interact to cause dramatic shifts in the distribution of welfare among farmers, marketers, and consumers. Marketers, who receive no surplus under perfect competition, given the constant returns to scale technologies assumed in the model, were able to capture half or more of the market surplus in many of the market environments studied.

Our analysis of the empirical work on measurement of market power in the food system indicated some disagreement as to the extent to which departures from perfect competition are observed. What are the policy implications of market power in the food chain when it is revealed? The results presented here indicate that pure deadweight loss effects are rather small for moderate levels of market power, but effects on distribution may be large. Should policy makers be concerned solely with efficiency, or should distribution also play a role?

Other policy-relevant questions not addressed here include the following: (i) What are the efficiency implications of increasing concentration? Is increasing concentration primarily efficiency driven, or does monopoly power breed inefficiencies and wasteful competition? (ii) How important are quality and variety as determinants of consumer welfare from food consumption, and how are quality and variety dimensions of food markets influenced by concentration and market power? (iii) Do powerful food manufacturers and retailers offset or countervail each other's market power to the betterment of producers and consumers? (iv) Can producers themselves exercise countervailing power though cooperatives and bargaining? (v) How effective are antitrust actions or regulations in curtailing food sector market power when it exists?

The current practice of enforcement in the U.S. is far from the activist policy advocated by the pioneers of industrial organization analysis in agriculture such as Hoffman (1940). Compare, for example, the subdued tone and modest recommendations contained in the recent report by the USDA Advisory Committee on Agricultural Concentration [USDA, (1996b)] with the activist recommendations issued 30 years earlier in a similar report by the National Commission on Food Marketing. Although markets are generally much more concentrated now than 30 years ago, the Advisory Committee's main recommendation is for enhanced disclosure and improved reporting of information. Ironically, mandated disclosure and reporting is known to be a good device to enforce cartel behavior. The Committee distances itself from recommendations that would "ultimately stunt opportunities for growth within the industry" (p.15), or "slow or prevent the industry's need to adapt to a changing market place" (p. 15).

Figure 1: Effect of the Choice of Demand Elasticity on the Calculation of Welfare Loss Due to Imperfect Competition

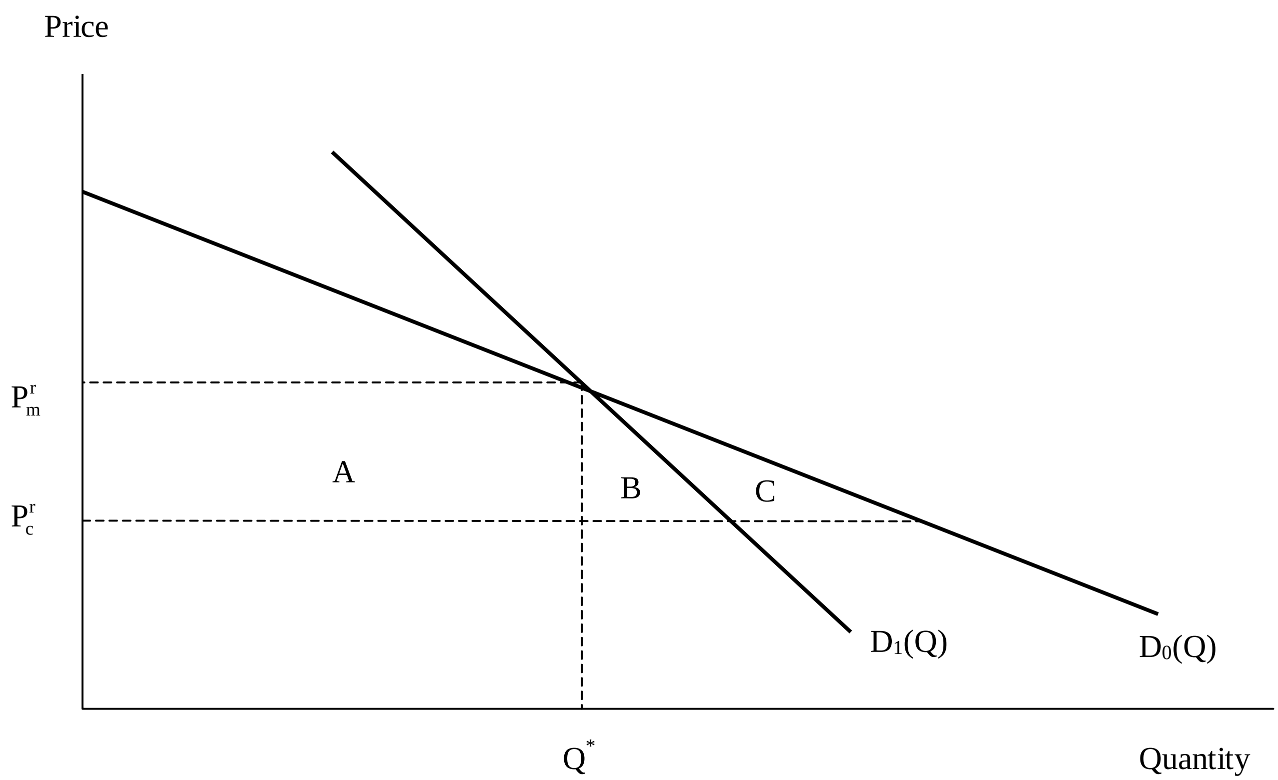
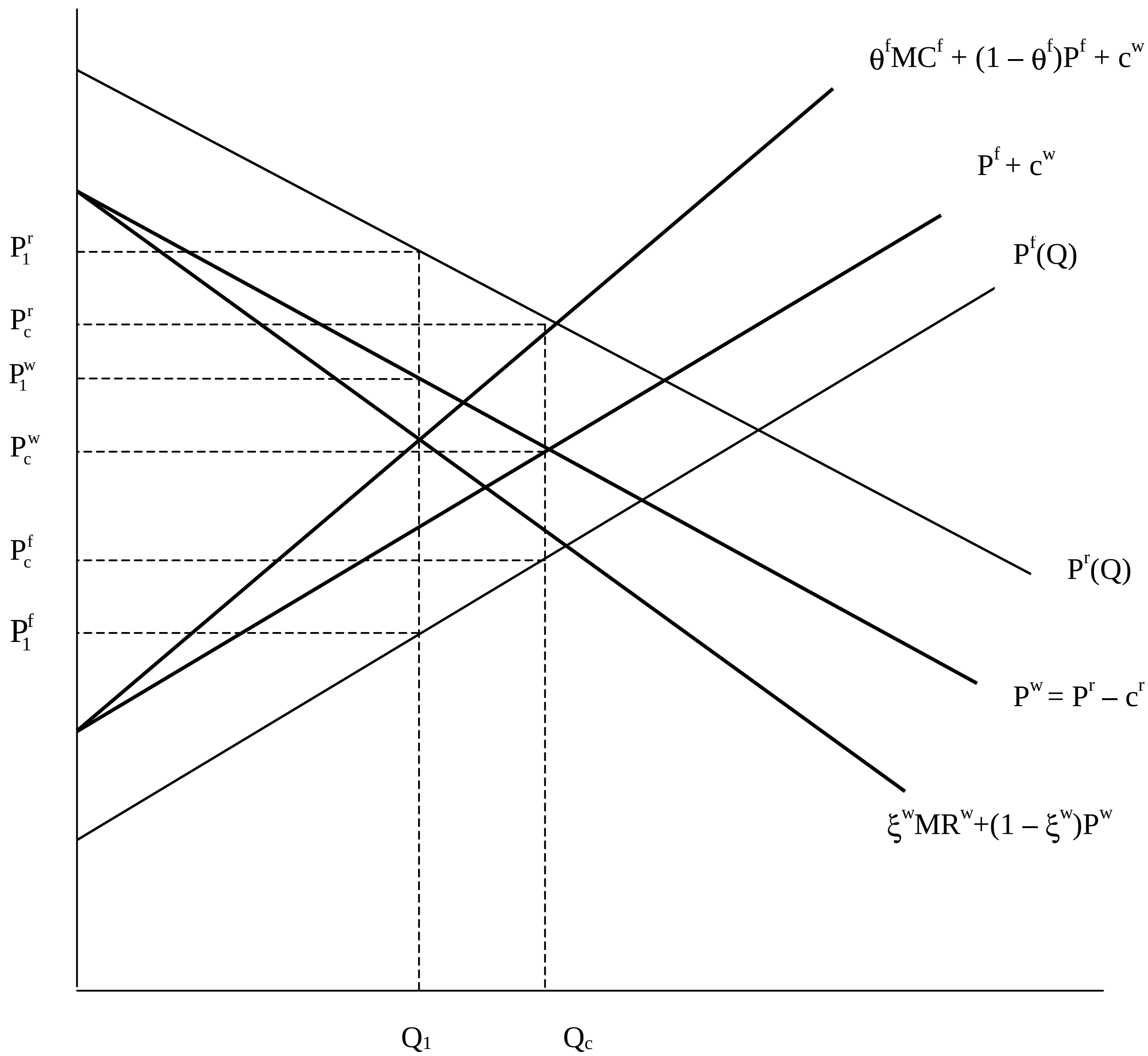
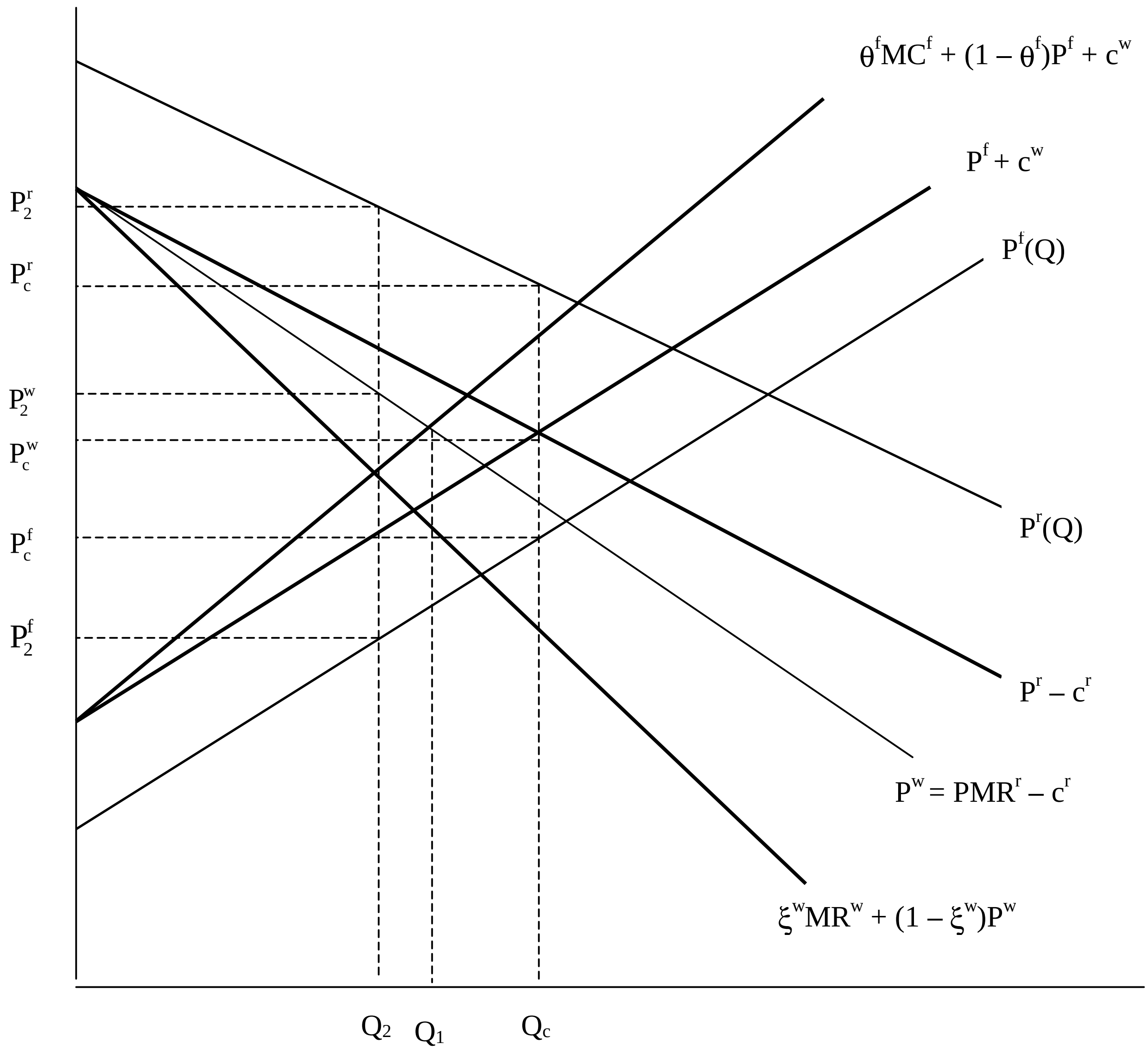


Figure 2: Market Equilibrium under Processor Oligopoly and Oligopsony Power



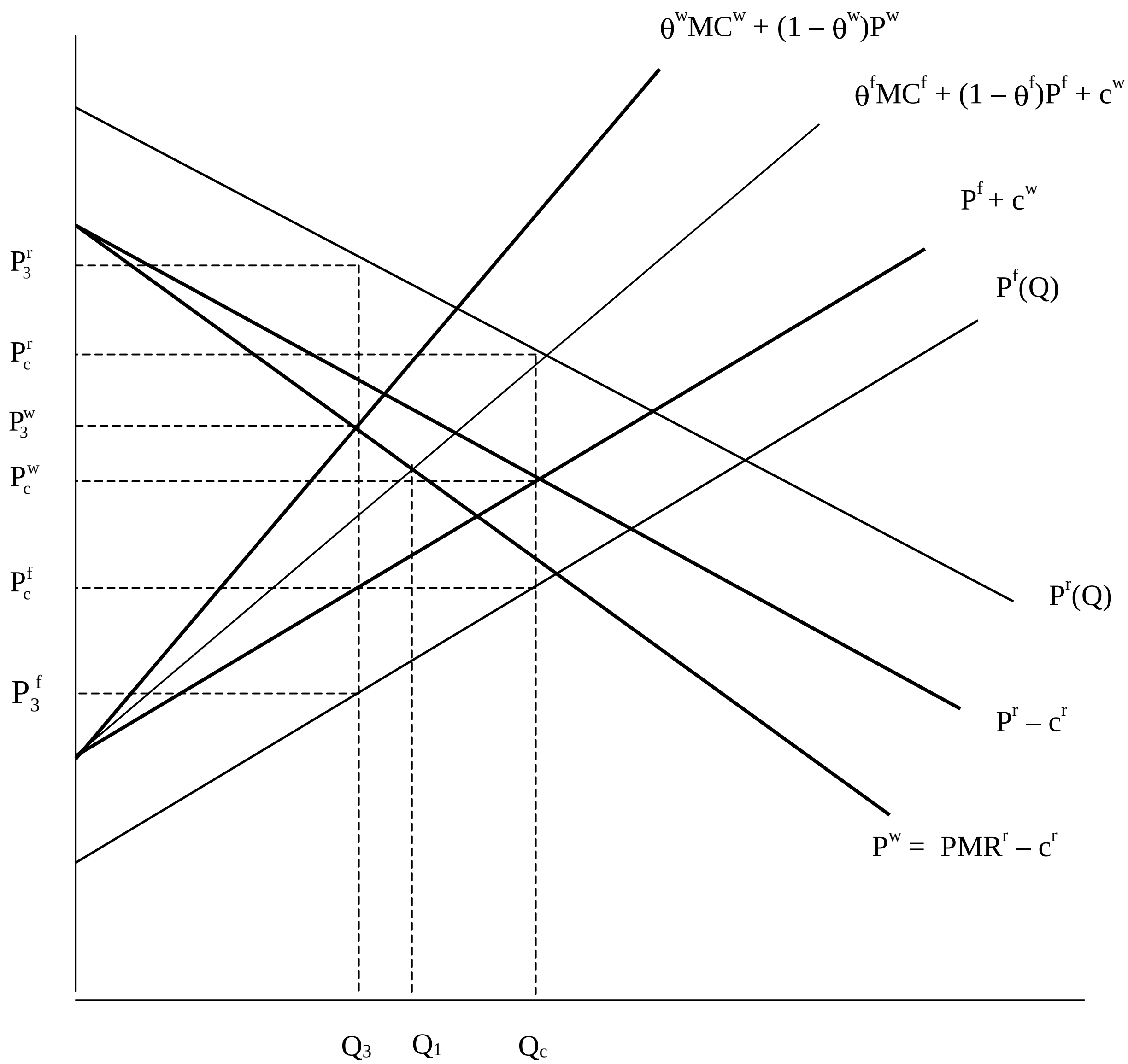

Note: Figure 2 illustrates the outcome for $\xi^w = \theta^w = 0.5$ (see footnote 17)

Figure 3: Successive Oligopoly Power with Processor Oligopsony Power




Note: Figure 3 illustrates the outcome when $\xi^w = \xi^r = \theta^f = 0.5$ (see footnote 17)

Figure 4: Successive Oligopsony Power with Retailer Oligopoly Power




Note: Figure 4 illustrates the outcome when $\theta^f = \theta^w = \xi^r = 0.5$ (see footnote 17)

Figure 5: The Effect of Oligopoly Power on Consumer Welfare

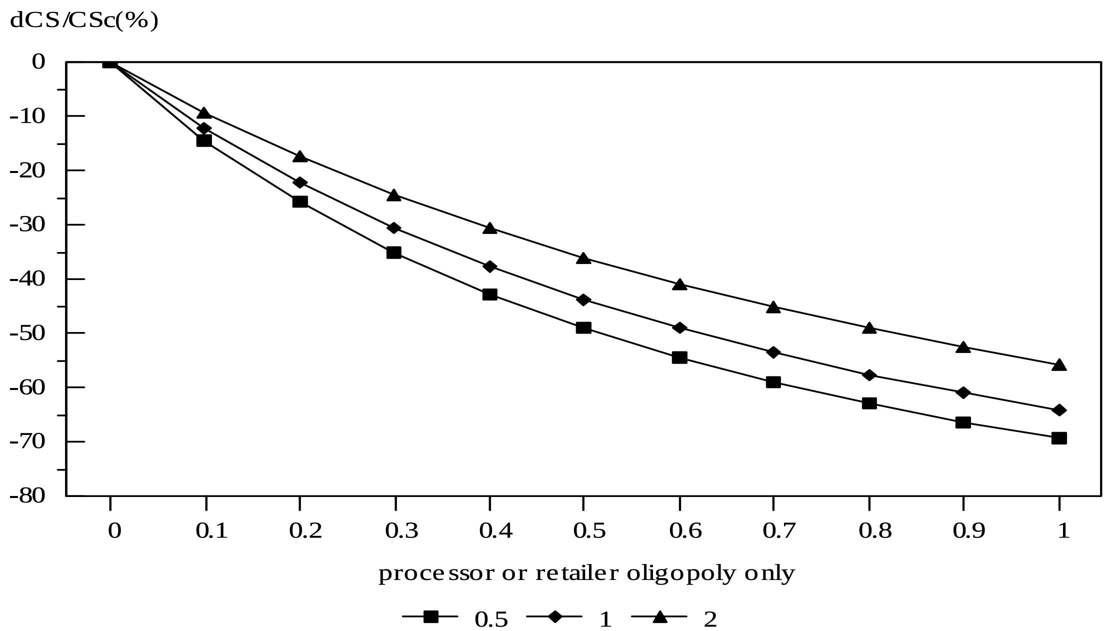



Figure 6: The Effect of Oligopsony Power on Consumer Welfare

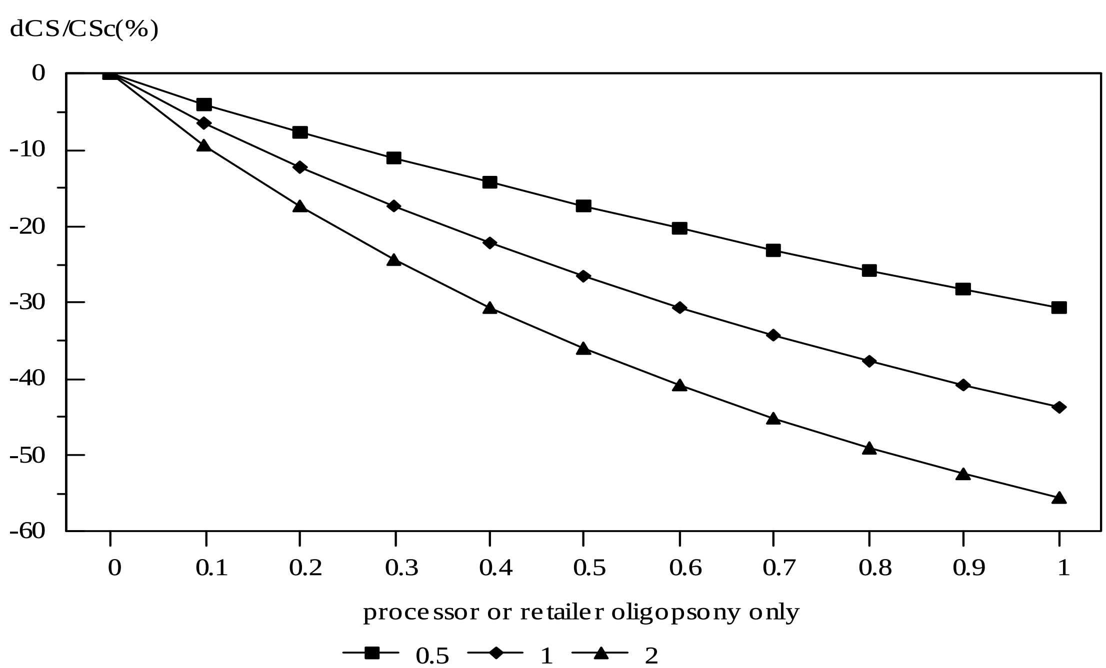


Figure 7: The Effect of Market Power on Consumer Welfare: $\phi$ = 1.0

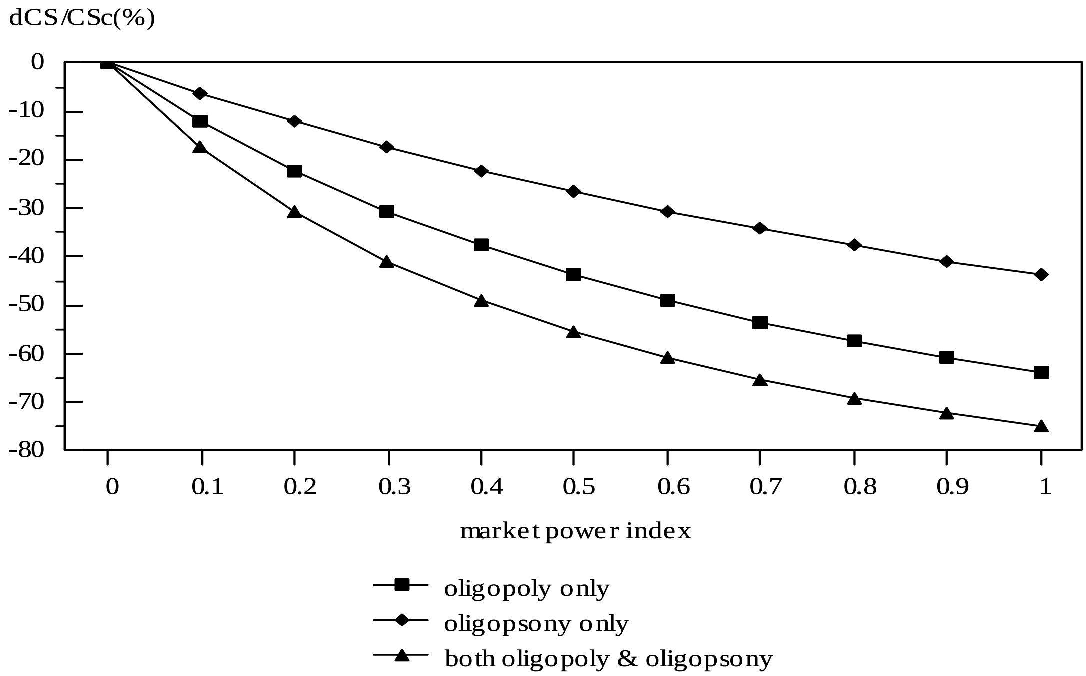



Figure 8: The Effect of Market Power on Total Welfare: $\phi$ = 1.0

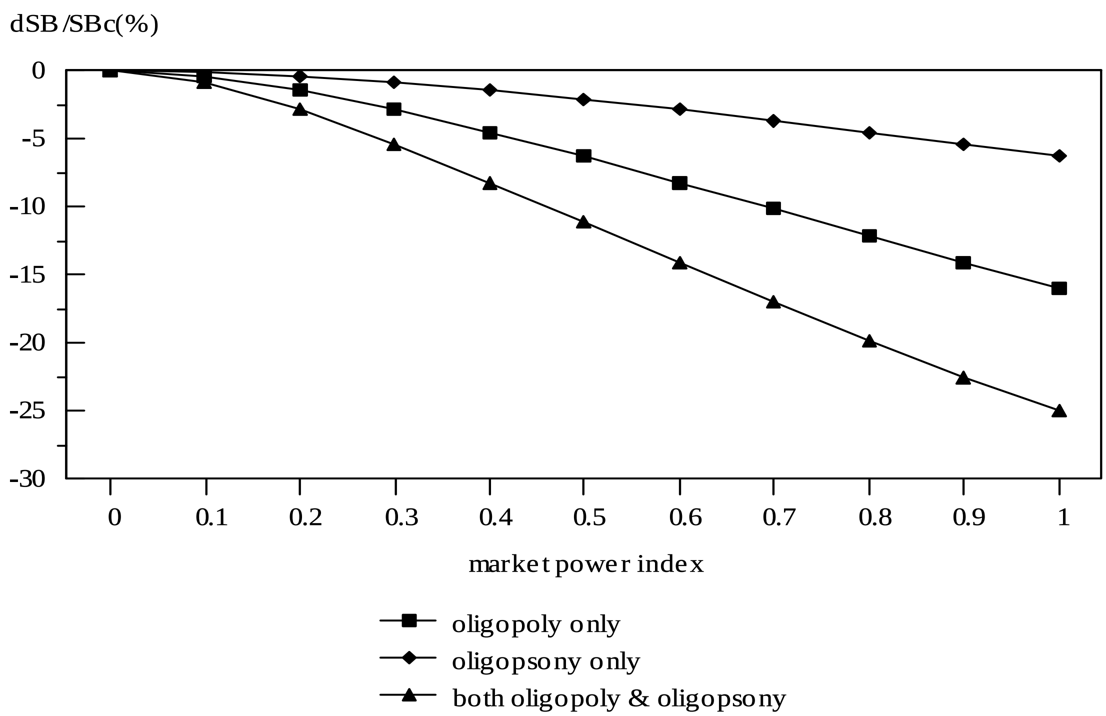


Figure 9: The Effect of Market Power on the Distribution of Welfare: $\phi$ = 1.0

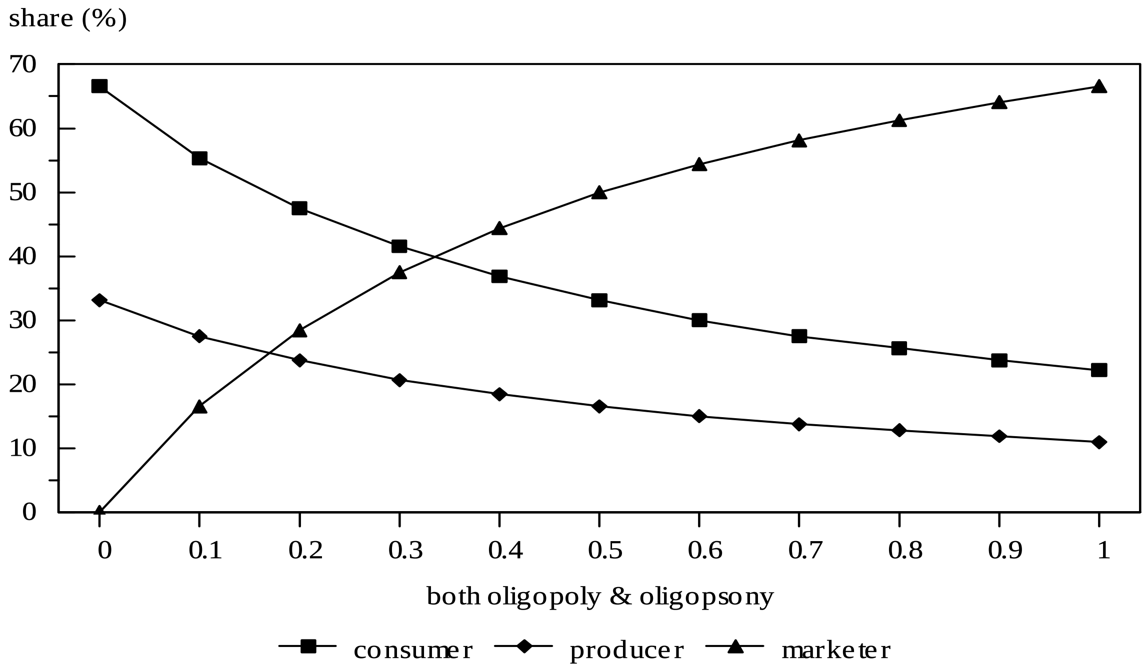



Figure 10: The Effect of Successive Market Power on Consumer Welfare: $\phi$ = 1.0

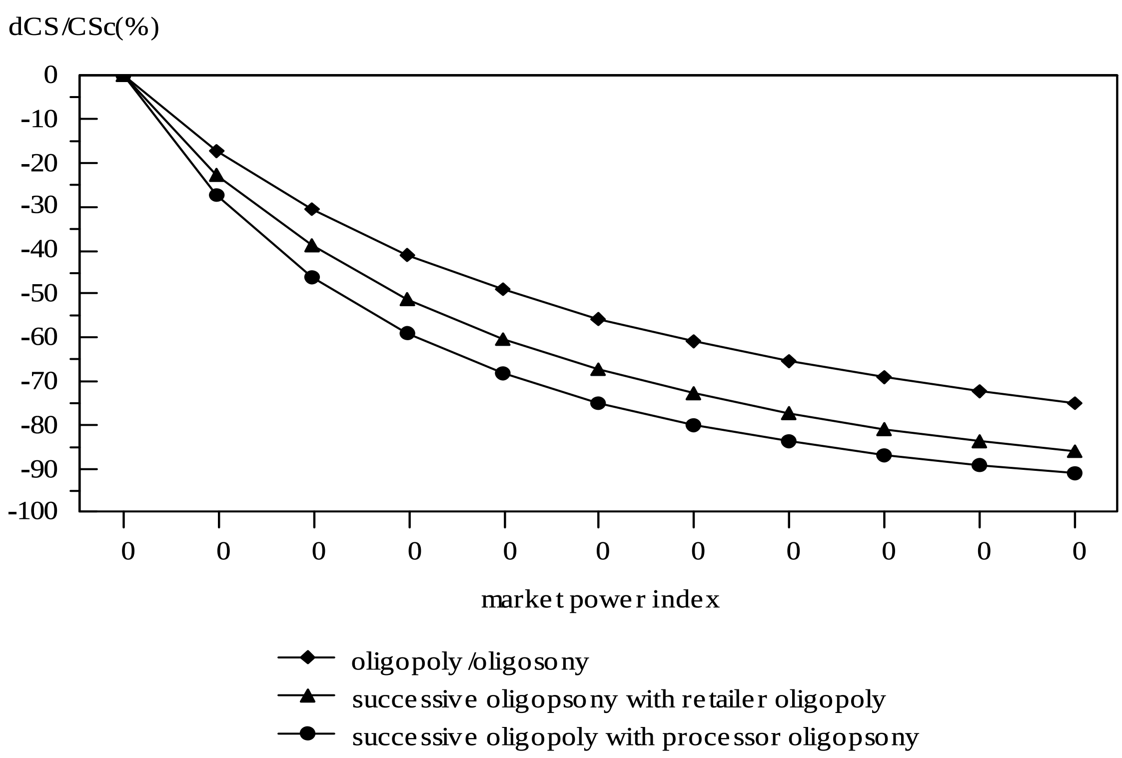


Figure 11: The Effect of Successive Market Power on Total Welfare: $\phi$ = 1.0

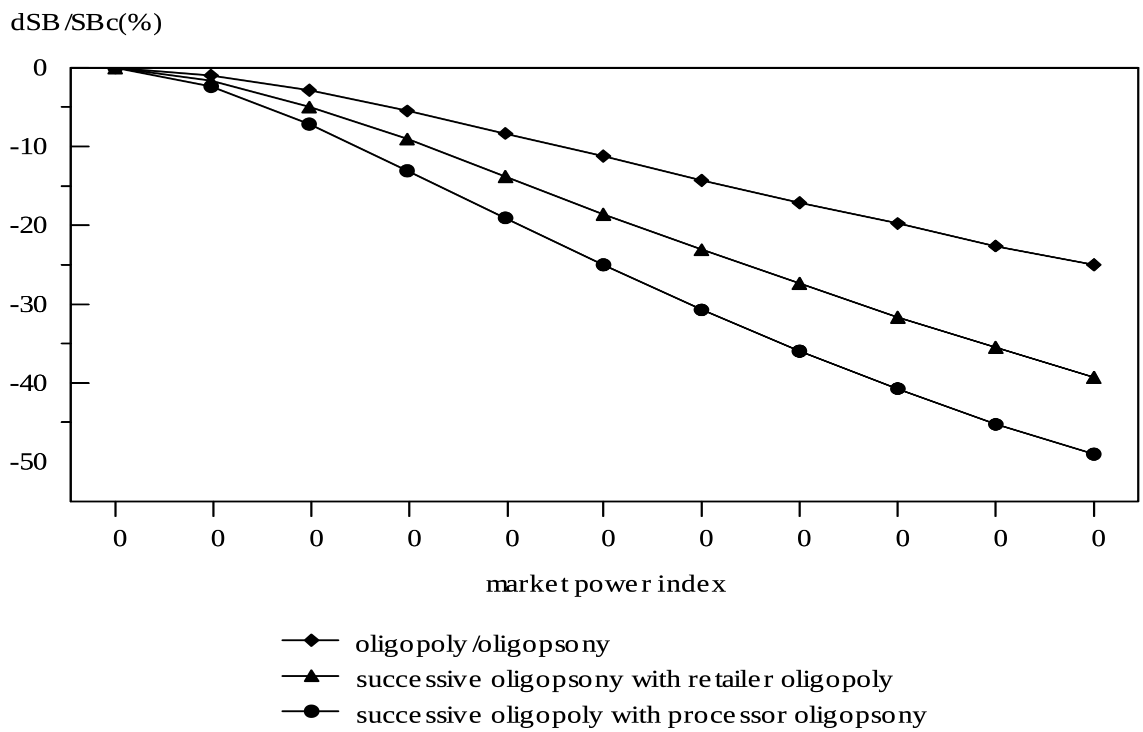



Figure 12: The Effect of Successive Oligopoly Power on the Distribution of Welfare:

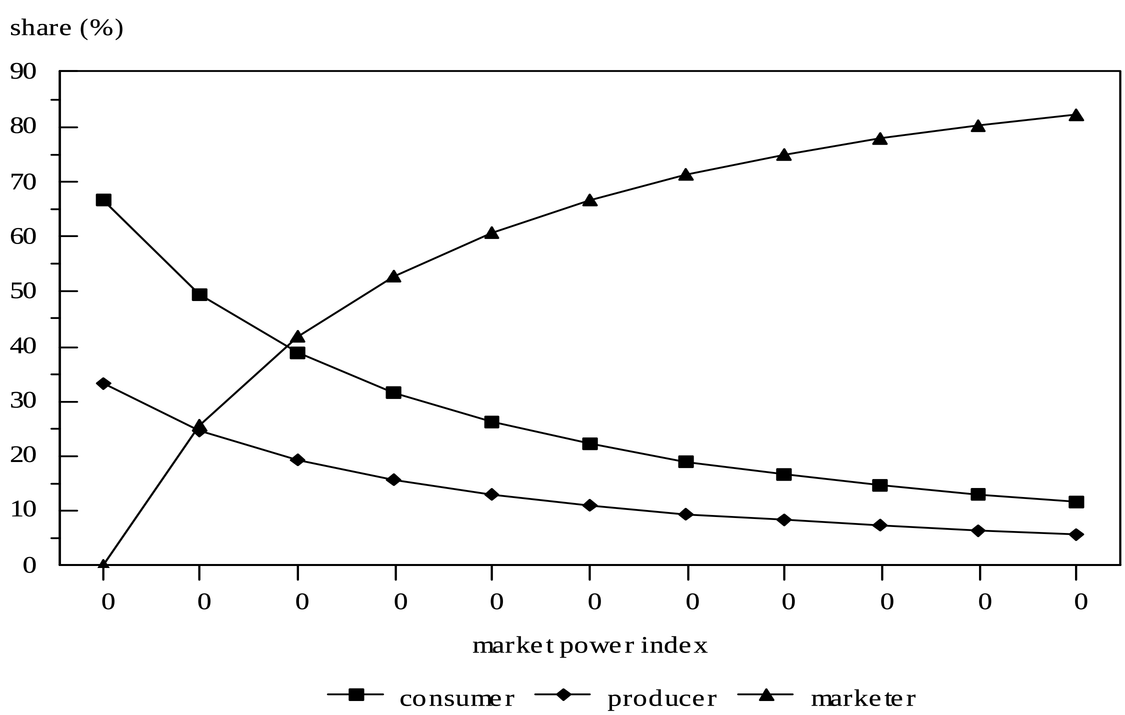
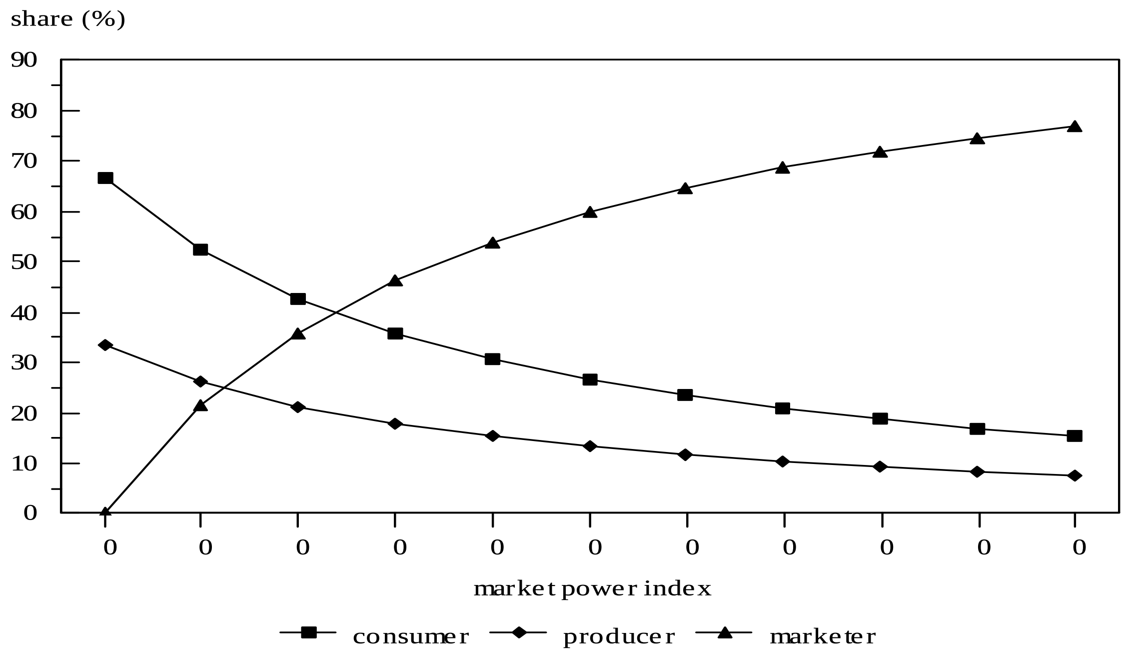


Figure 13: The Effect of Successive Oligopsony Power on the Distribution of Welfare: $\phi = 1.0$



**References**

Alston, J.M., R.J. Sexton, and M. Zhang, 1997, The effects of imperfect competition on the size and distribution of research benefits, *American Journal of Agricultural Economics* 79, 1252-1265.

Ashenfelter, O. and D. Sullivan, 1987, Nonparametric tests of market structure: An application to the cigarette industry, *Journal of Industrial Economics* 35, 483-498.

Azzam, A., 1992, Testing the competitiveness of food price spreads, *Journal of Agricultural Economics* 43, 248-256.

Azzam, A., 1997, Measuring market power and cost-efficiency effects of industrial concentration, *Journal of Industrial Economics* 45, 377-386.

Azzam, A. and E. Pagoulatos, 1990, Testing oligopolistic and oligopsonistic behavior: an application to the U.S. meat packing industry, *Journal of Agricultural Economics* 41, 362-370.

Azzam, A. and J.R. Schroeter, 1995, The tradeoff between oligopsony power and cost efficiency in horizontal consolidation: an example from beef packing, *American Journal of Agricultural Economics* 77, 825-836.

Azzam, A. and D. Anderson, 1996, Assessing competition in meatpacking: economic history, theory, and evidence, USDA Grain Inspection, Packers and Stockyards Administration, GIPSA-RR 96-6.

Bhuyan, S. and R.A. Lopez, 1995, Welfare losses under alternative oligopoly regimes: the U.S. food and tobacco manufacturing industries, *Journal of Agricultural and Applied Economics* 27, 577-587.

Bhuyan, S. and R.A. Lopez, 1997, Oligopoly power in the food and tobacco industries, *American Journal of Agricultural Economics* 79, 1035-1043.

Binkley, J.K. and J.M. Connor, 1998, Market competition and metropolitan area grocery prices, *Journal of Retailing* 74, 273-293.

Bresnahan, T.F., 1989, The oligopoly solution concept is identified. In: R. Schmalensee and R Willig, eds., *The Handbook of Industrial Organization,*Vol. 2, Amsterdam: North Holland.

Connor, J.M. and E.B. Peterson, 1992, Market-structure determinants of national brand-private label price differences of manufactured food products, *Journal of*

*Industrial Economics* 40, 157-171.

Corts, K.S., 1998, Conduct parameters and the measurement of market power, *Journal of Econometrics* 88, 227-250.

Cotterill, R.W., 1986, Market power in the retail food industry: evidence from Vermont, *Review of Economics and Statistics* 68, 379-386.

Cotterill, R.W., 1993, *Competitive Strategy Analysis in the Food System* (Westview Press, Boulder, CO).

Cotterill, R.W. and C.D. Harper, 1995, Market power and the Demsetz quality critique: an evaluation for food retailing, Food Marketing Policy Center, Research Report No.29, University of Connecticut.

Demsetz, H., 1973, Industry structure, market rivalry, and public policy, *Journal of Law and Economics* 16, 1-9.

Durham, C.A. and R.J. Sexton, 1992, Oligopsony potential in agriculture: residual supply estimation in California's processing tomato market, *American Journal of Agricultural Economics* 74, 962-972.

Fisher, F.M. and J.J. McGowan, 1983, On the misuse of accounting rates of returns to infer monopoly profits, *American Economic Review* 73, 82-87.

Franklin, A.W. and R.W. Cotterill, 1993, An analysis of local market concentration levels and trends in the U.S. grocery retailing industry, University of Connecticut, Food Marketing Policy Research Center, Research Report No. 19.

Gardner, B., 1975, The farm retail price spread in a competitive industry, *American Journal of Agricultural Economics* 57, 399-409.

Gasmi, F., J.J. Laffont, and Q. Vuong, 1992, Econometric analysis of collusive behavior in a soft-drink market, *Journal of Economics and Management Strategy* 1, 277-311.

Gasmi, F. and Q. Vuong, 1991, An econometric analysis of some duopolistic games in prices and advertising, in: G. Rhodes, and T. Fomby, eds., *Advances in econometrics: econometric methods and models for industrial organization* (JAI Press, Greenwich, CT) 225-254.

Genesove, D. and W.P. Mullin, 1998, Testing static oligopoly models: conduct and cost in the sugar industry, 1890-1914, *Rand Journal of Economics* 29, 355-377.

Gisser, M., 1982, Welfare implications of oligopoly in U.S. food manufacturing, *American Journal of Agricultural Economics* 64, 616-624.

Hall, L., A. Schmitz and J. Cothern, 1979, Beef wholesale-retail marketing margins and concentration, *Economica* 46, 295-300.

Hoffman, A.C., 1940, *Large-Scale Organization in the Food Industry* (U.S. Government Printing Office, Washington, D.C.).

Holloway, G., 1991, The farm-retail price spread in an imperfectly competitive food industry, *American Journal of Agricultural Economics* 73, 979-987.

Hyde, C.E. and J.M. Perloff, 1994, Can monopsony power be estimated?, *American Journal of Agricultural Economics* 76, 1151-1155.

Hyde, C.E. and J.M. Perloff, 1998, Multimarket market power estimation: the Australian retail meat sector, *Applied Economics* 30, 1169-1176.

Just, R.E and W.S. Chern, 1980, Tomatoes, technology, and oligopsony, *Bell Journal of Economics* 11, 584-602.

Kambhampaty, S.M., P.J. Driscoll, W.D. Purcell, and E.B. Peterson, 1996, Effects of concentration on prices paid for cattle, USDA Grain Inspection, Packers and Stockyards Administration, GIPSA-RR 96-4.

Karp, L.S. and J.M. Perloff, 1996, Dynamic models of oligopoly in rice and coffee export markets, in: D. Martimort, ed., *Agricultural markets: mechanisms, failures and regulations* (North-Holland, Amsterdam) 171-204.

Kaufman, P. and C. Handy, 1989, Supermarket prices and price differences, USDA ERS Technical Bulletin 1176.

Lamm, R.M., 1981, Prices and concentration in the food retailing industry, *Journal of Industrial Economics* 30, 67-78.

Liu, D.J., C-H. Sun, and H.M. Kaiser, 1995, Market conduct under government price intervention in the U.S. dairy industry, *Journal of Agricultural and Resource Economics* 20, 301-315.

Love, H.A. and C.R. Shumway, 1994, Nonparametric tests for monopsonistic market power exertion, *American Journal of Agricultural Economics* 76, 1156-1162.

Madhavan, A.N., R.T. Masson and W.H. Lesser, 1994, Cooperation for monopolization? An empirical analysis of cartelization, *Review of Economics and Statistics* 76, 161-175.

Marion, B.W. and F.E. Geithman, 1995, Concentration-price relations in regional fed cattle markets, *Review of Industrial Organization* 10, 1-19.

Marion, B.W., K. Heimforth, and W. Bailey, 1993, Strategic groups, competition, and retail food prices, in: R.W. Cotterill, ed., *Competitive strategy analysis in the food system* (Westview Press, Boulder, CO) 179-199.

Masson, R.T. and P.M. Eisenstat, 1980, Welfare impacts of milk orders and the antitrust immunities for cooperatives, *American Journal of Agricultural Economics* 62, 270-278.

Melnick, R. and H. Shalit, 1985, Estimating the market for tomatoes, *American Journal of Agricultural Economics* 6, 147-153.

Menkhaus, D.J., J.S. St. Clair and A.Z. Ahmaddaud, 1981, The effects of industry structure on price: a case in the beef industry, *Western Journal of Agricultural Economics* 6, 147-153.

Muth, M., 1996, Identifying the degree of oligopoly power in the beef packing industry, Unpublished Manuscript, North Carolina State University.

Muth, M. and M.K. Wohlgenant, 1999, A general method of measuring the degree of oligopsony power with fewer data requirements, *Journal of Agricultural and Resource Economics* 24, in press.

Newmark, C.M., 1990, A new test of the price-concentration relationship in grocery retailing, *Economics Letters* 33, 369-373.

Pagoulatos, E. and R. Sorensen, 1986, What determines the elasticity of industry demand? *International Journal of Industrial Organization* 4, 237-250.

Parker, R.C. and J.M. Connor, 1979, Estimates of consumer loss due to monopoly in the U.S. food-manufacturing industries, *American Journal of Agricultural Economics* 61, 628-639.

Peterson, E.B. and J.M. Connor, 1996, Consumer welfare loss estimates for differentiated food product markets, *Review of Agricultural Economics* 18, 233-246.

Posner, R.A., 1975, The social costs of monopoly, *Journal of Political Economy* 83, 807-827.

Purcell, W.D., 1990, Structural change in the livestock sector: causes, implications, continuing issues, in: W.D. Purcell, ed., *Structural change in* *livestock: causes, implications, alternatives* (Research Institute on Livestock Pricing, Blacksburg, VA) 2-57.

Quail, G., B. Marion, F. Geithman, and J. Marquardt, 1986, The impact of packer buyer concentration on live cattle prices, Working Paper, North Central Project 117, North Central Agricultural Experimental Stations, Madison, WI.

Raper, K.C. and H.A. Love, and C.R. Shumway, 1998, Distinguishing the source of market power: an application to cigarette manufacturing, Faculty Paper No. 98-17, Texas A&M University.

Reed, A.J. and J.S. Clark, 2000, Structural change and competition in seven U.S. food markets, U.S. Department of Agriculture, Economic Research Service, Technical Bulletin No. 1881.

Rogers, R.T., 1997, The role of marketing cooperatives in increasingly concentrated agricultural markets: reaction, in: M. Cook, R. Torgerson, T. Sporleder, and D. Padberg, eds., *Cooperatives: their importance in the future food and agricultural system* (National Council of Farmer Cooperatives, Washington, D.C.).

Rogers, R.T. and R.J. Sexton, 1994, Assessing the importance of oligopsony power in agricultural markets, *American Journal of Agricultural Economics* 76, 1143-1150.

Schroeter, J.R., 1988, Estimating the degree of market power in the beef packing industry, *Review of Economics and Statistics* 70, 158-162.

Schroeter, J.R. and A. Azzam, 1990, Measuring market power in multi-product oligopolies: the U.S. meat industry, *Applied Economics* 22, 1365-1376.

Sexton, R.J. and M. Zhang, 2000, Optimal commodity promotion in imperfectly competitive markets, working paper, Department of Agricultural and Resource Economics, University of California, Davis.

Sexton, R.J., C.L. Kling, and H.F. Carman, 1991, Market integration, efficiency of arbitrage, and imperfect competition: methodology and application to U.S. celery, *American Journal of Agricultural Economics* 73, 568-580.

Suzuki, N., H.M. Kaiser, J.E. Lenz, and O.D. Forker, 1994a, An analysis of U.S. dairy policy deregulation using an imperfect competition model, *Agricultural and Resource Economics Review* 23, 84-93.

Taylor, T.G. and R.L Kilmer, 1988, An analysis of market structure and pricing in the Florida celery industry, *Southern Journal of Agricultural Economics* 20, 35-43.

Texas A&M Agricultural Market Research Center, 1996, Price determination in slaughter cattle procurement, USDA Grain Inspection, Packers and Stockyards Administration, GIPSA-RR 96-2.

Triffin, A.L. and P.J. Dawson, 1997, Measuring oligopolistic distortion in the UK frozen potato product sector: a calibration modelling approach, *Journal of Agricultural Economics* 48, 300-312.

USDA, 1996b, Concentration in agriculture: a report of the USDA Advisory Committee on agricultural concentration, Agricultural Marketing Service.

Wann, J.J. and R.J. Sexton, 1992, Imperfect competition in multiproduct food industries with application to pear processing, *American Journal of Agricultural Economics* 74, 980-990.

Ward, C.E., 1981, Short-period pricing models for fed cattle and impacts of wholesale carcass beef and live cattle futures market prices, *Southern Journal of Agricultural Economics* 13, 125-132.

Ward, C.E., 1982, Relationship between fed cattle market shares and prices paid by beefpackers in localized markets, *Western Journal of Agricultural Economics* 7, 79-86.

Ward, C.E., 1988, *Meatpacking Competition and Pricing* (Research Institute on Livestock Pricing, Blacksburg, VA).

Ward, C.E., 1992, Inter-firm differences in fed cattle prices in the Southern Plains, *American Journal of Agricultural Economics* 74, 480-485.

Wohlgenant, M.K., 1989, Demand for farm output in a complete system of demand functions, *American Journal of Agricultural Economics* 71, 241-252.

Young, D.P.T., 1997, Dominant firms, price leadership and the measurement of monopoly welfare losses, *International Journal of Industrial Organization* 15, 533-547.

Yu, C-C. and J.M. Connor, 2000, Retesting the price-concentration relationship in grocery retailing, *Agribusiness*, in press.